Back bonding nov 14

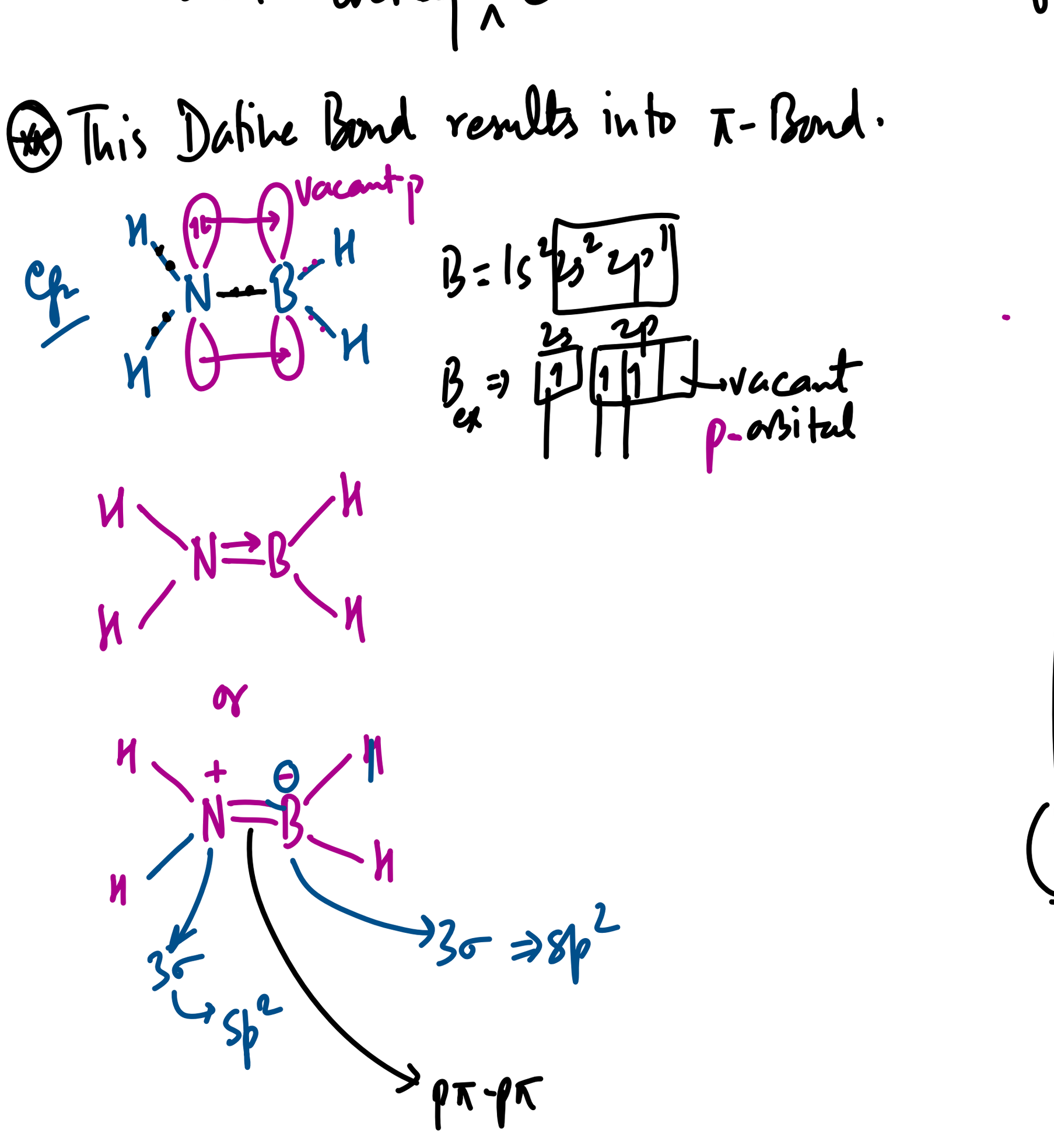
Sunday, November 13, 2022 10:47 AM

Back Bonding

Dative Bond within the molecule is called Back Bonding.

↳ orbital overlap of e⁻ rich atom & e⁻ deficient atom.

(#) This Dative Bond results into π-Bond.



A → Atom with L.p: eg N, O, F, $\bar{C}$ (P2); P S Cl (P3); Br (P4); I (P5)

L.p ✓ Vacant orbital ✗ → perfect Donor, Belong to P2

L.p ✓ Vacant d ✓

B → Atom with vacant orbital: p-vacant (octet incomplete) → perfect acceptor, eg B, Be, $\overset{+}{C}$, Al; d-vacant (octet complete) (3s 3p full) eg P, S, Cl, Si, Br, I

(#) Due to Back-Bonding, π-Bond character develops

→ Bond length less than expected.

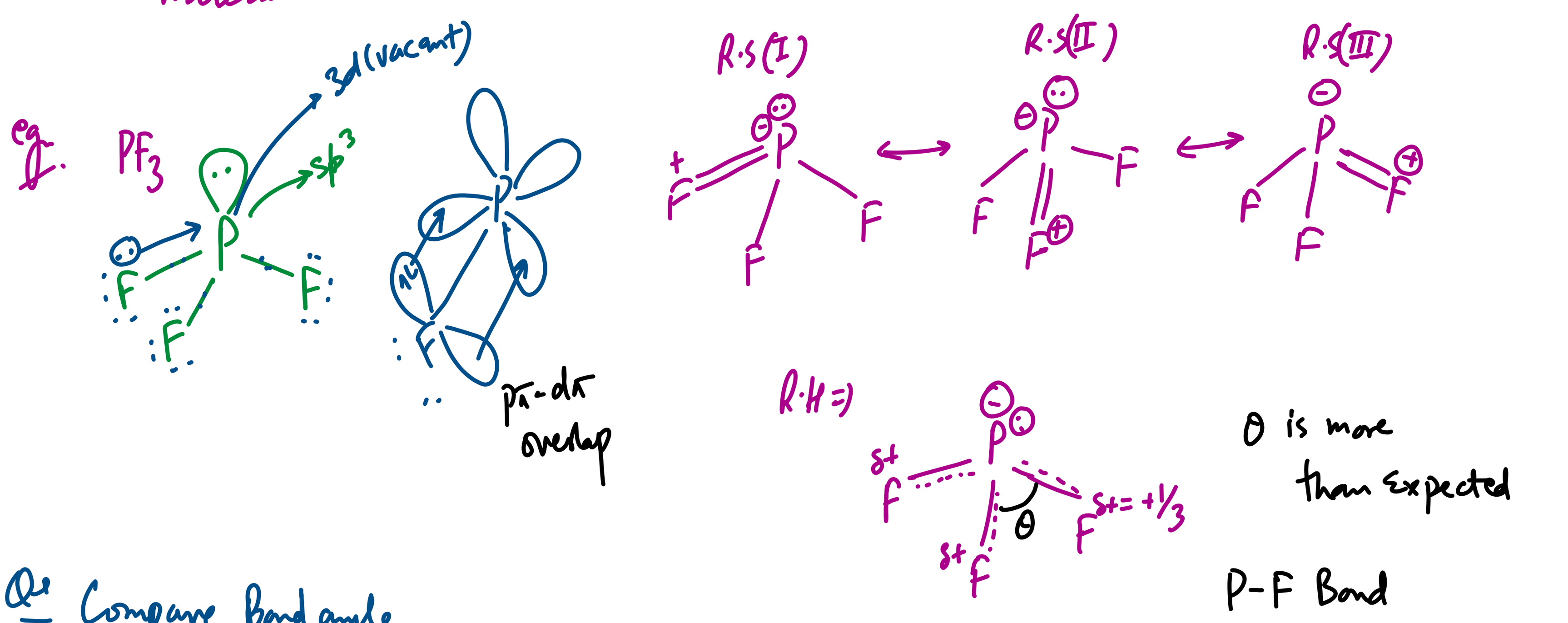
→ Bond strength more than expected.

→ Bond Angle may or may not increase

↑ when center atom have vacant d

Same " " " " " p

(#) Rule 1 & 2 of Bond Angle works if No Back-Bonding is present in molecule.



θ is more than expected

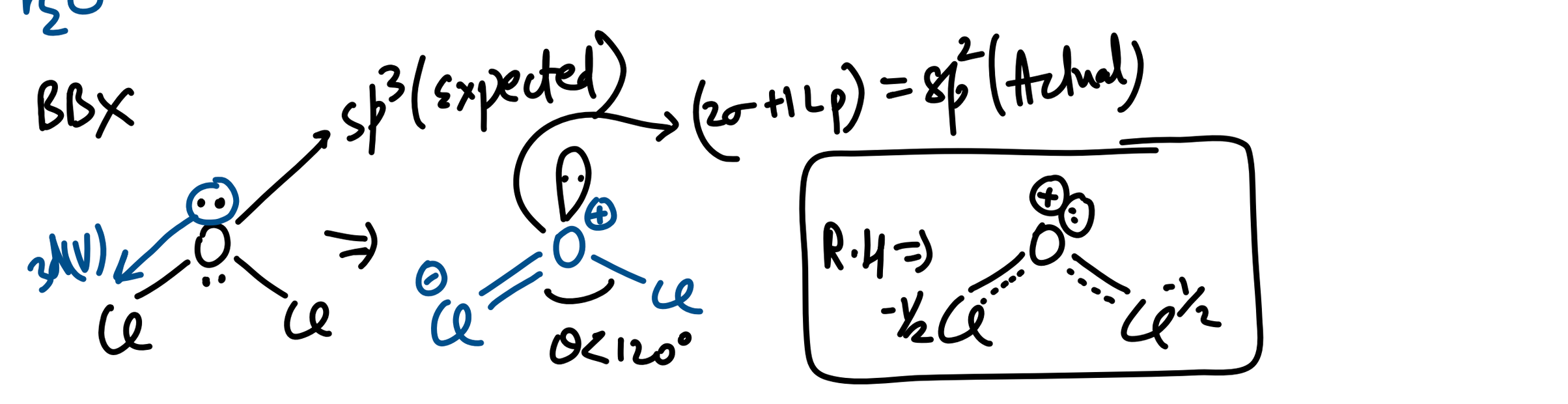
P-F Bond length is less than single P-F Bond

Q. Compare Bond angle

1) NF_3 & NH_3 (No BB, No BB) Rule 1 ⇒ β > α

2) PF_3 & PH_3 (BB ✓, BB ✗) Rule 1 → ✗ Angle (PF_3 > PH_3) due to BB

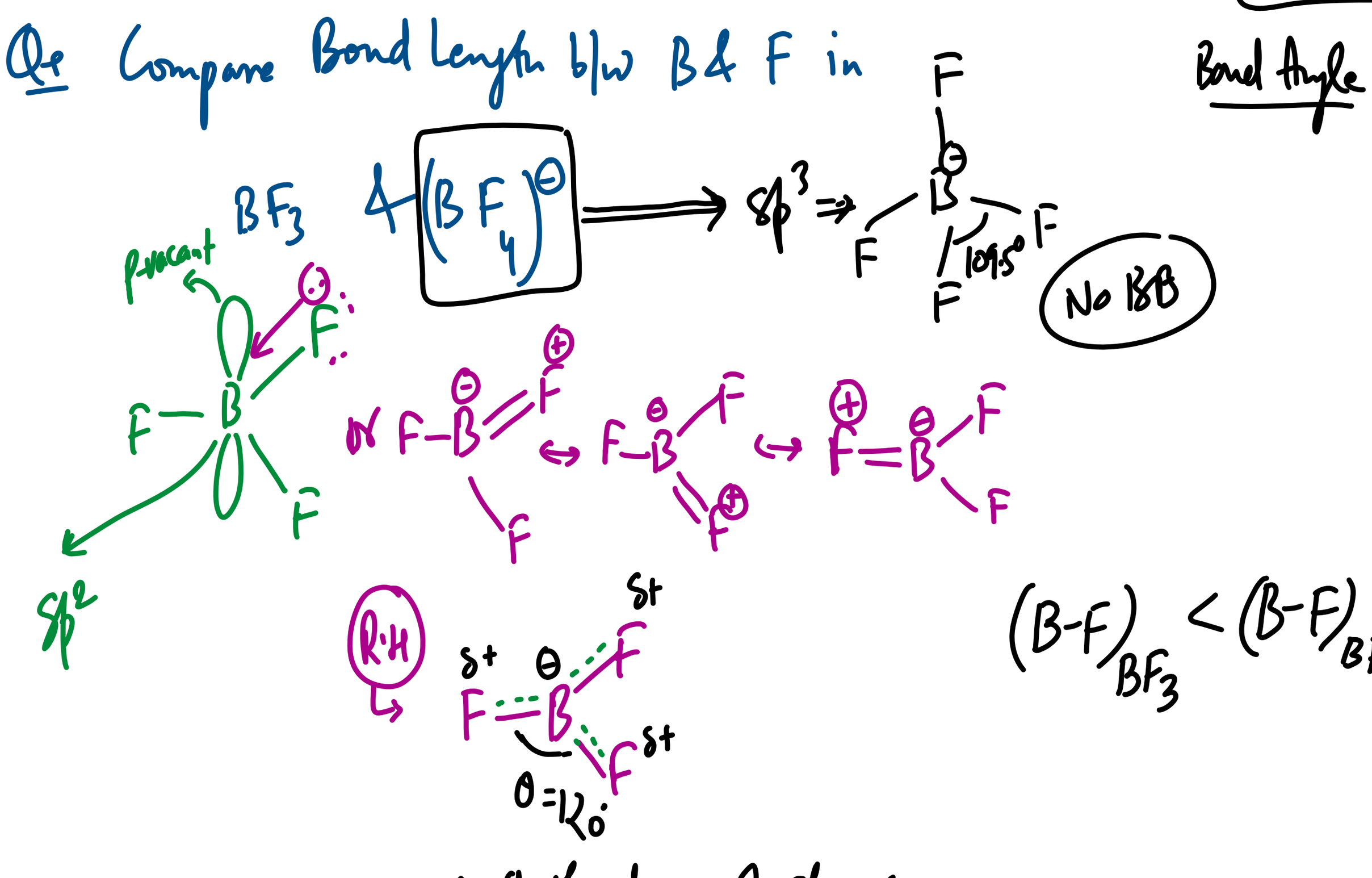
3) a) OF_2 b) Cl_2O c) H_2O — BB ✗, BB ✓, BB ✗ — a & c Compare Rule 1



Bond Angle H_2O > OF_2

Bond Angle: Cl_2O > H_2O > OF_2

Q. Compare Bond length b/w B & F in BF_3 & $(BF_4)^{\ominus}$



$(B-F)_{BF_3} < (B-F)_{BF_4^{\ominus}}$

• angle does not change

• B-F Bond length less than single B-F Bond

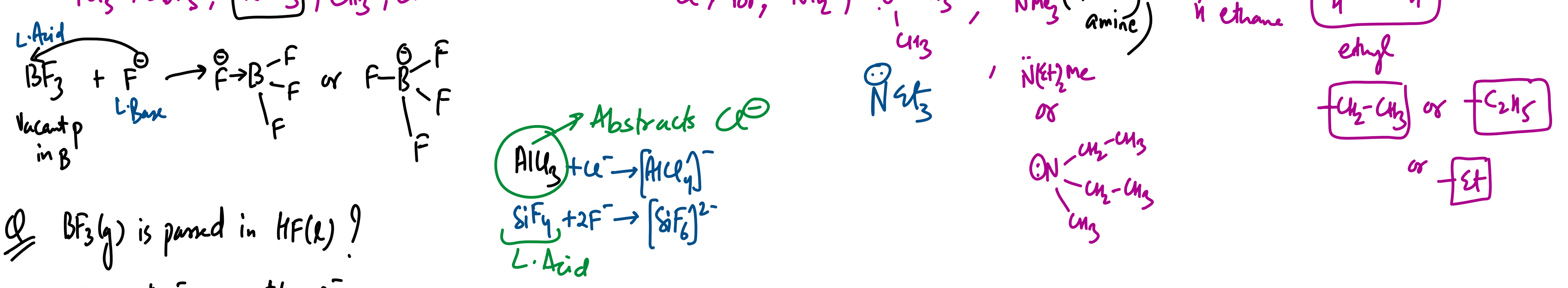
(#) Lewis Acid :- Species which are e⁻ deficient & can accept e⁻

↳ (Pond) Vacant orbital must be present

eg BF_3, BH_3, $BeCl_2$, $SiCl_4$, SiF_4, PCl_5, SbF_5, $AlCl_3$, $\overset{\oplus}{C}H_3$, etc.

Lewis Base :- Species which can donate e⁻ pair to other Species (Lewis Acid)

eg $\ddot{N}H_3$, $\ddot{P}H_3$, $H_2\ddot{O}$, $\bar{O}H$, F^-, Cl^-, Br^-, $\bar{N}H_2$, $\ddot{O}(CH_3)_2$, $\ddot{N}Me_3$ (trimethyl amine), $\ddot{N}Et_3$, $\ddot{N}(Et)Me_2$



Q $BF_3(g)$ is passed in HF(l) ?

$BF_3 + H^+F^- \longrightarrow H^+(BF_4)^-$

Fluoroboric Acid

(#) Etching of Glass (SiO_2)$_n$ by HF(l)

$SiO_2 + 4HF(l) \rightarrow SiF_4(Amor) + H_2O$

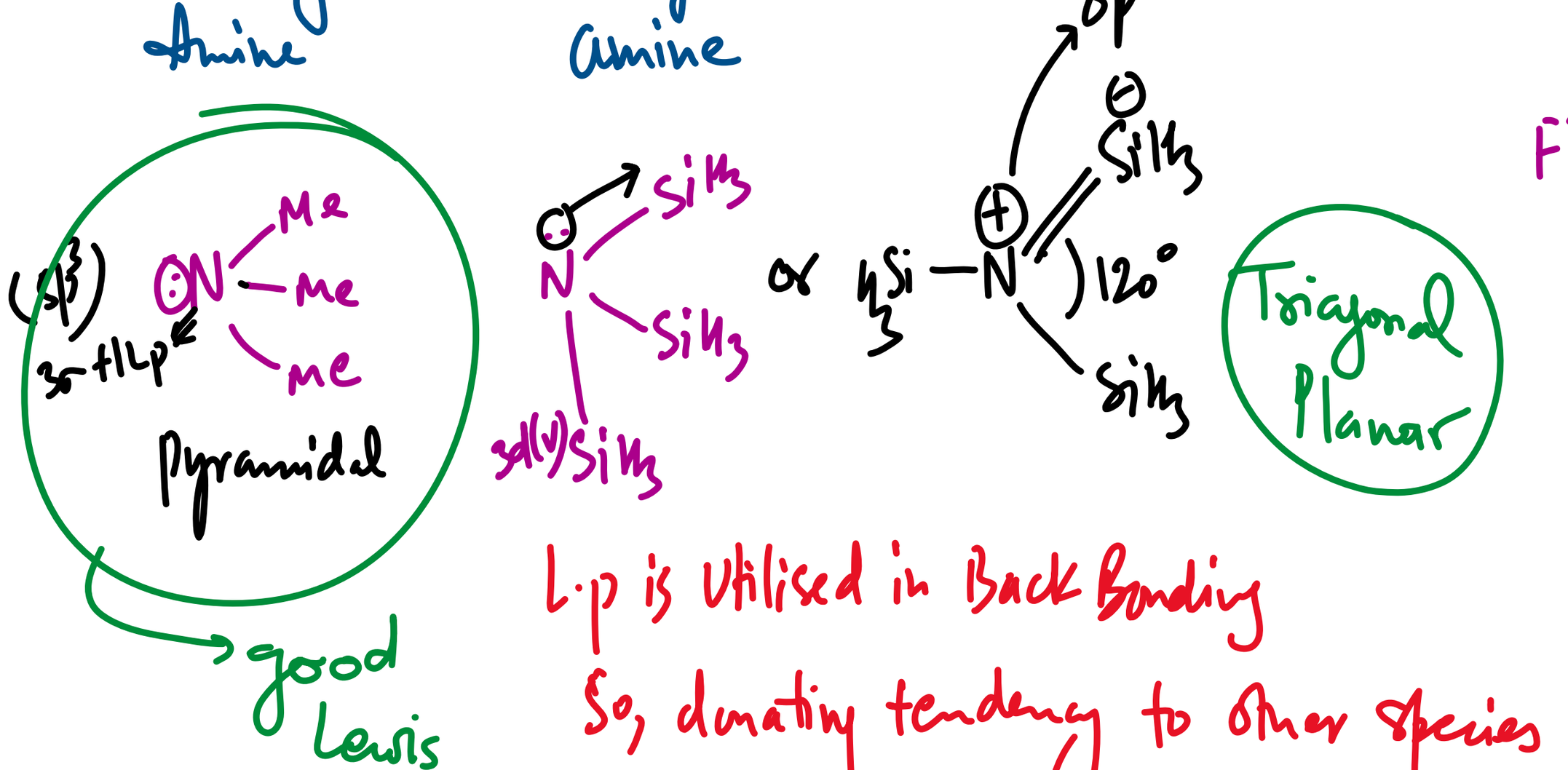
↓ 2HF

$H_2[SiF_6]$ Waxy deposit — Fluorosilicic Acid

$Si(OH)_4$ Silicic Acid

Q. BASIC Strength order :- $-SiH_3$ Silyl

1) $N(CH_3)_3$ & $N(SiH_3)_3$ — Trimethyl Amine, Trisilyl amine



L.p is utilised in Back Bonding

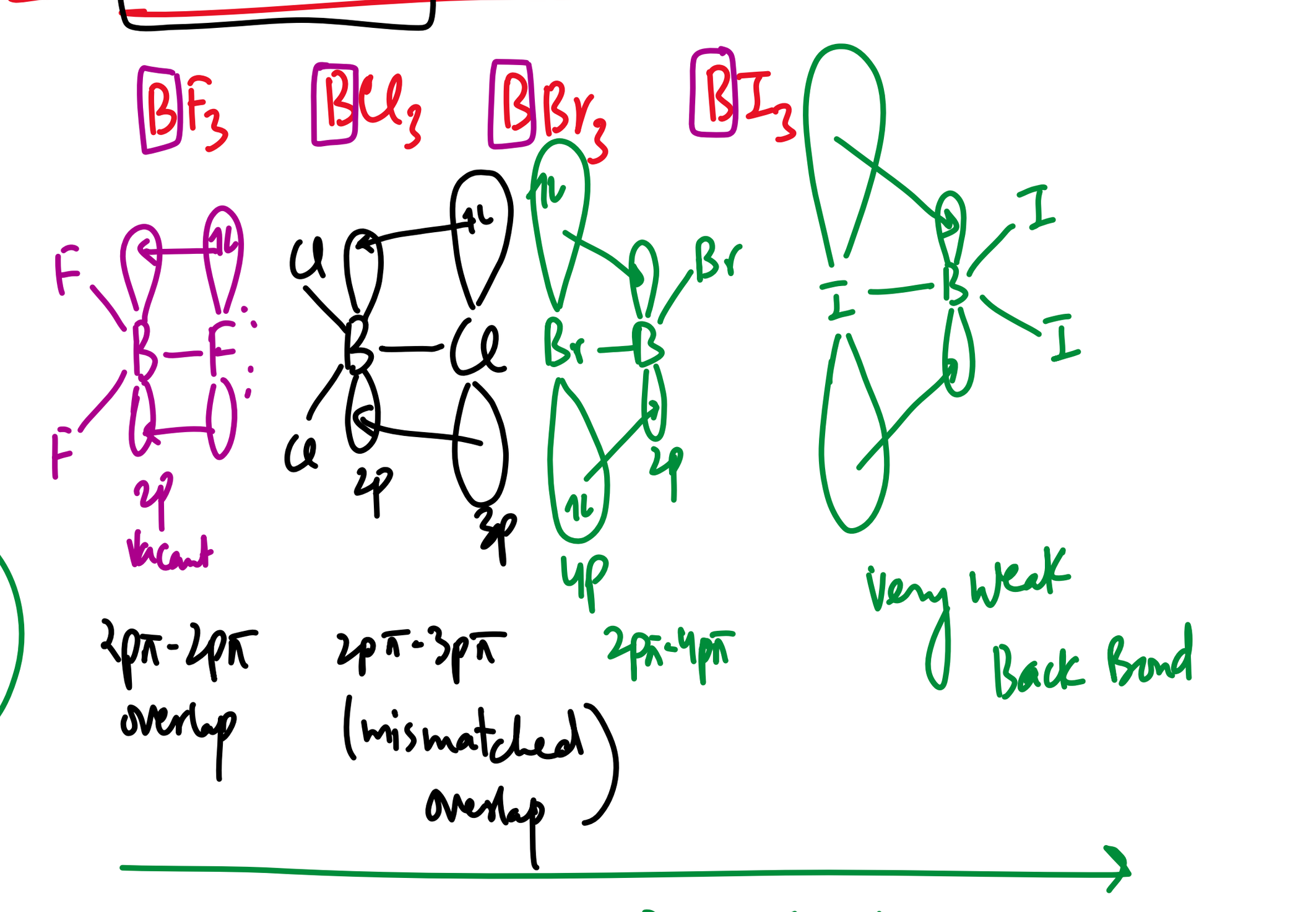
So, donating tendency to other species

Les, BASIC str. Les

BASIC: $N(CH_3)_3 > N(SiH_3)_3$

Q. Lewis Acidic str. order :- (Tendency to accept e⁻ from other species (L.Base))

BF_3, BCl_3, BBr_3, BI_3



BACK Bonding ↓

Need of Boron ↑

Lewis Acidic str. ↑

$BF_3 < BCl_3 < BBr_3 < BI_3$